Technical Report #5

January 1963

SOCIAL ISOLATION AND SOCIAL INTERACTION:
A BEHAVIORAL AND PHYSIOLOGICAL COMPARISON

David Shapiro, P. Herbert Leiderman,

and Mona E. Morningstar

Harvard Medical School

Department of Psychiatry

Prepared for:

Office of Naval Research
Group Psychology Branch

Contract Nour-1866(43)
NR 170-518

Social Isolation and Social Interaction: A Behavioral and Physiological Comparison

David Shapiro, P. Herbert Leiderman, and Mona E. Morningstar[1]

Harvard Medical School

The assessment of the effects of social stimuli on the individual is an important issue in social psychology. Interest in the problem has been rekindled by recent experimental work in social isolation and sensory deprivation where attempts have been made to distinguish and evaluate the effects of the presence and absence of specific stimulus variables on the individual (Solomon, Kubzansky, Leiderman, Mendelson, Trumbull, and Wexler, 1961). Although this research has dealt primarily with physical aspects of the environment, it has also called attention to the importance of the social environment for any individual. As stated by Petrullo (1962, p. 233), "If interaction is an important factor in the determination of behavior, lack of participation in interaction or exclusion from interaction may have as profound effects as sensory deprivation has been shown to have."

It is our aim in the present study to evaluate the effects of the presence or absence of social stimuli by comparing the responses of the same individuals in isolation and in interaction situations. We use a simple task in which success and failure can be manipulated and made equivalent for both social conditions. On the assumption that the order in which the individual experiences the task, that is, whether alone or in a group, might have a significant effect on his response, the order was balanced. This assumption derives in part from the

work of Sherif (1936) who demonstrated that the influence of the group on individual perception depended on temporal order.

To assess individual response, we use an experimental approach which has been applied previously in the study of initiation roles in group interaction (Leiderman and Shapiro, in press). This approach makes it possible to examine responses on a physiological as well as on a behavioral level. The following hypotheses will be investigated:

1. Behavioral and physiological responses differ as a function of social condition, isolation or interaction, and the order in which the individual experiences these conditions.

2. Initial experience in a group situation leads to greater individual consistency of behavioral and physiological responses than initial experience in isolation.

Method

Experimental Procedure

The experimental task consisted of a contrived game which can be played by individuals or groups (Levin and Shapiro, 1962; Leiderman and Shapiro, in press). In the game, subjects (Ss) are asked to guess the order of colors on a list in the possession of the experimenter (E). A guess is made by pressing one of six buttons on a control box in front of each S. Each button lights one of six bulbs corresponding to the color selected as shown on a panel placed in the center of the table around which Ss sit.

In the interaction condition, each group of three Ss was asked to discuss each decision, come to agreement, and press the button of the same color at the same time for the center light to go on. In the

isolation condition, each S played the game alone and was asked to discuss his reasons out loud before making each guess and pressing the button to turn the light on.

Ss were brought into the experimental room by a female technician who attached Galvanic Skin Potential (GSP) electrodes on the thenar eminence of the left palm and on the dorsal surface of the left forearm, approximately 20 cm apart. Electrocardiograph electrodes were attached to the upper arms. Ss used their right hand to press buttons. After an initial 15-minute rest period, instructions were read by the E and each S was given two practice trials. Similar instructions were used for individuals and groups. Instructions to groups were as follows:

Now we want you to take part in a guessing game. This is how it works. In the other room I have a long list of colors written down, and you have to guess each color on my list and try to get as many right as possible.

Your job is to talk it over with each other and decide what the color is each time. As you do, please discuss how you arrived at your decision, and also name the color you are going to choose for each guess. Speak distinctly so that you can be understood. As soon as all three of you agree on a color, you stop talking and turn on the light by pressing the button of the color on the box in front of you. All three buttons have to be down for the light to go on. You keep the light on until you find out whether you guessed right or wrong. If you guessed right, you will hear a sound like this (tone). If you guessed wrong, you will hear a sound like this (buzzer). As soon as you find out

how you did, turn off the light. Whether you guessed right or wrong, I'll go on to the next color on my list and you have to guess that one. It may be the same color as the last one, or it may be different.

Let's try one for practice. Suppose you all talked it over and agreed on red. Try it. (They do. Buzzer.) That means your guess was wrong. (If they do it wrong: You hold it down until you find out whether you guessed right or wrong.) Try red again. (They do. Tone.) That's right. The colors are red, brown, yellow, green, grey, and blue. Remember, all three of you discuss how you arrived at your decision each time. Do not talk while the light is on. Try to get as many right as possible. Any questions?

When you hear a long tone, start guessing immediately and keep on guessing. When you hear another long tone, it is time to stop. At the end, please sit quietly, do not talk or move around.

After the 5-minute instruction period the E left the room and the S began to play the game. Reinforcement was given 5 seconds after each guess in the form of a pleasant tone for a correct response and an unpleasant buzzer for an incorrect one. The intensity of the sounds was 72 decibels, each lasting 1.5 seconds.

Physiological responses were recorded continuously during each session on an Offner Type R (transistorized) dynagraph. Details on experimental apparatus, recording equipment, and laboratory may be found in Leiderman and Shapiro (in press); Turasky, Leiderman, and Shapiro (1962); and Leiderman, Sherwood, and Kaufmann (in preparation).

Subjects and Design

The Ss were 84 women, 81 student nurses and three college students, in the age range 18-21. Ss were paid $1.50 per hour.

Each S was studied in two conditions, isolation (I) and interaction (G) in two experimental sessions (1,2). In I each S played the game alone; in G the same Ss played the game in groups of three. For 54 Ss, the experimental order was I first and G second (I_1-G_2); for 30 Ss, the order of condition was reversed (G_1-I_2). Time between sessions varied from one to five days. Ss were randomly assigned to groups and randomly seated within each group.

The same non-contingent random reinforcement schedule was used for the game in all sessions. The reinforcement was given as a positive or negative stimulus after each trial. It was presented at random, that is, unrelated to the behavior of the Ss. The reinforcement schedule was varied, beginning with an initial low level of success, followed by increasing levels of success and a final period of low success. The positive reinforcement ratios used were successively 1/6, 1/3, 2/3, and 1/6, each in force for 10 minutes, for a total game period of 40 minutes. Following the game, Ss were required to rest for 15 minutes, making a total of 75 minutes in the laboratory. There was no time limit for each guess; individuals or groups were free to respond at their own rate.

Measures

Measures were derived on the basis of the S's continuous behavioral and physiological activity during each of the four 10-minute experimental periods and for the initial and final rest periods. For statistical and correlational analysis a single number representing the entire 40-minute game period was used for each variable.

Initiations. In I, the behavioral index for each S was the number of initiations (responses) made by a S per minute ($\bar{X}$ Init.). In G, the behavioral index was the number of trials per minute in which each S was the first of the three to initiate a color guess which was finally agreed upon by the group. The name of the color had to be stated verbally for a color nomination to be called an initiation. Number of initiations per minute per group was used as an index of total group response. Both correct and incorrect initiations were included in the counts of behavioral acts.

It was assumed that the initiation of acts of the individual in isolation and the initiation of decisions in groups represents a behavioral dimension common to both situations.

The mean square successive difference of the response data was used as a measure of the variability of behavior (d^2 Init.). This statistic was computed by averaging the squared deviation between number of responses for each successive minute. The statistic takes into account the shifts in rate of initiations that may occur over time. The same statistic, d^2, was also used in the analysis of physiological variability (Leiderman and Shapiro, 1962; von Neumann, Kent, Bellinson, and Hart, 1941).

Galvanic Skin Potential (GSP). GSP was recorded as a basal level continuously throughout each experimental session for each S. It is the difference in DC potential between an active and an inactive sweat area of the skin. GSP is a cholinergically mediated sympathetic response assumed to reflect level of activation. For purposes of quantitative analysis, the continuous basal levels of GSP were sampled at successive

1-minute intervals giving 20 observations for the initial rest and instruction period, 10 observations for each of the four experimental periods or 40 for the entire game period, and 15 observations for the final rest period.[2] This one-a-minute sampling rate detects changes in basal level occurring more slowly than once a minute. It ignores changes in specific and non-specific galvanic skin responses (GSR) which usually have a time duration of 10-20 seconds. Two statistics were used in the analysis of differences in basal levels of GSP: (a) The mean ($\bar{X}$ GSP) or central tendency of the basal level was computed by taking the arithmetic average of the sampled values. (b) The mean square successive difference (d^2GSP) describes the variability of the basal level and was computed by averaging the squared deviation between each successive 1-minute value (Leiderman and Shapiro, 1962).

Heart Rate (HR). HR was recorded continuously throughout each session. Unlike GSP, HR is under both cholinergic parasympathetic and adrenergic sympathetic control and therefore reflects the state of autonomic balance of the cardiovascular system. HR is used in this study as a physiological index of the effect of moderate stress on the individual. It was measured by counting the number of beats per 12-second block at each minute observation point.[3] The values for each 12-second period were then expressed in terms of beats per minute. Two statistics were used: (a) The mean ($\bar{X}$ HR) describes the average heart rate for any set of sampled observations. (b) The mean square successive difference (d^2HR) describes the variability of the changing heart rate computed in the same way as d^2GSP.

Results

Interest in the guessing game remained relatively high for Ss during the two experimental sessions. Ss appeared to accept the game at face value and in no case did they say, either during or after the sessions, that the connection between guessing and success or failure was arbitrary. Three approaches to the game were generally observed: (a) trying to find a logical pattern in the sequence of correct and incorrect color guesses, (b) using a non-logical or intuitive system in guessing, and (c) associating objects in the room or elsewhere as a way of choosing colors. The logical approach occurred less frequently than the other two. None of the approaches appeared related to the behavioral and physiological measures.

The results for each of the six measures are presented separately in graphic form. Numerical values representing the entire experimental period (40 minutes) are given in Table 1 for each measure. Correlations between I_1 and G_2, G_1 and I_2, for each measure are shown in Table 2.

Initiations

Mean Initiation ($\bar{X}$ Init.). In Figure 1 the means of $\bar{X}$ Init. are shown for individuals alone and for 3-person groups taken as units. Highest response rates tended to occur under 2/3 reinforcement followed by a fall-off in the subsequent 1/6 period. Changes were significant only in I_1 where 35 of 54 Ss rose from the 1/3 period to the 2/3 period (2 ties, $p < .05$), and 34 of the 54 fell off in the following 1/6 period (2 ties, $p < .05$).

Order did not have a significant effect on initiation rate. Of the 84 Ss in the entire sample, only two made fewer initiations during

Table 1

Mean Values of Behavioral and Physiological Measures During Experimental Period

	Order I_1-G_2 (N = 54) Condition		Order G_1-I_2 (N = 30) Condition	
	I_1	G_2	I_2	G_1
Measure				
$\bar{X}$ Init.	3.62	2.70	3.52	2.37
d^2 Init.	1.69	1.23	1.86	1.00
$\bar{X}$ GSP	19.9	21.6	15.8	22.8
d^2 GSP	9.2	8.7	7.4	10.8
$\bar{X}$ HR	85.7	83.2	80.5	81.4
d^2 HR	34.5	41.5	37.0	40.0

Table 2

Consistency of Individual Differences Across Isolation and Interaction Conditions

		Measure					
Order	N	$\bar{X}$ Init.	d^2 Init.	$\bar{X}$ GSP	d^2 GSP	$\bar{X}$ HR	d^2 HR
$I_1 - G_2$	54	.04	-.05	.24	.65*	.57*	.22
$G_1 - I_2$	30	.54*	-.10	.50*	.54*	.69*	.28

* $p < .01$

N	SYMBOL	ORDER	CONDITION
54	△---△ ○——○	1 2	INDIVIDUAL GROUP
30	▲——▲ ●---●	1 2	GROUP INDIVIDUAL

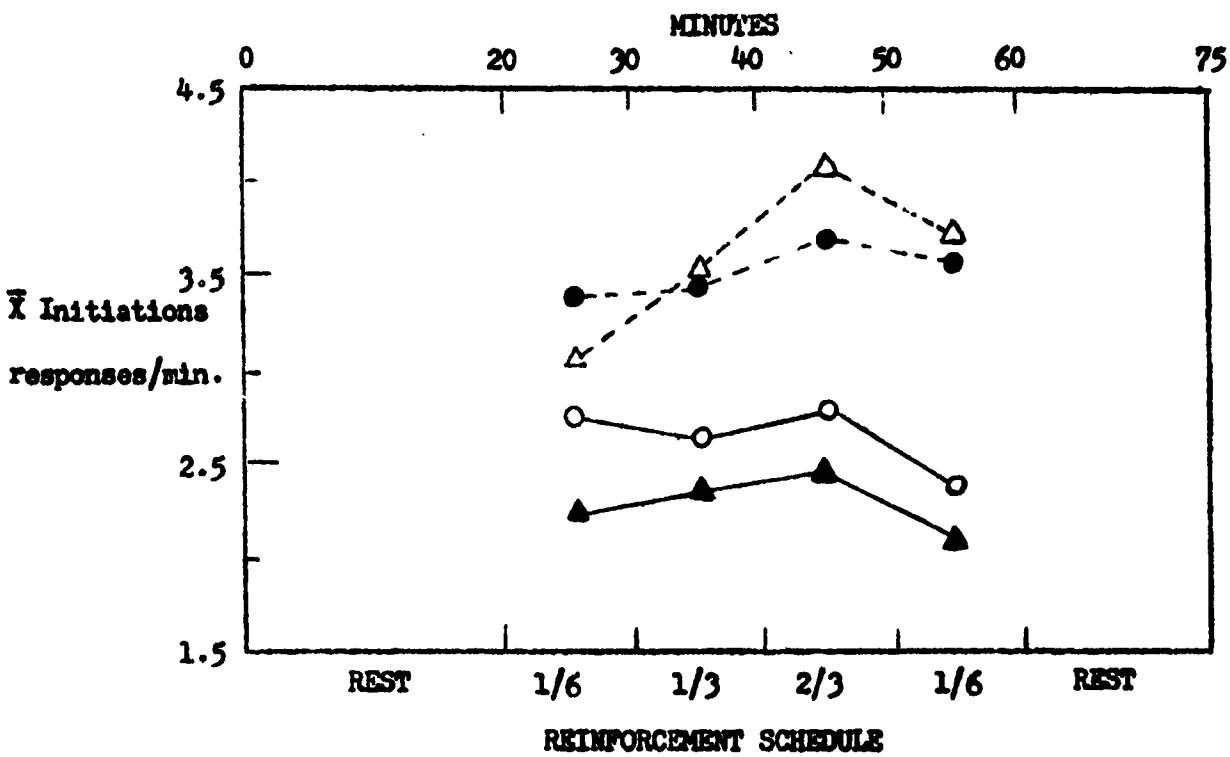

Fig. 1. Means of $\bar{X}$ initiations.

the entire game period when alone than they did when in interaction with others. Individuals in isolation were also more productive of initiations as compared with the total responses of three persons in groups.

As to the consistency of response for Ss between social conditions, the rank-order correlation for initiations was .04 (ns) for I_1-G_2 and .54 ($p < .01$) for G_1-I_2. Ss were more consistent relative to one another in initiation rate if they interacted with others first and then performed alone than vice versa.

Mean Square Successive Difference Initiation (d^2 Init.). The data for d^2 Init. are shown in Figure 2. Values of d^2 Init. showed no significant changes in relation to task reinforcement ratio but tended to be higher under 2/3 reinforcement as compared with 1/3, in all instances. For the entire game period, d^2 Init. was higher in I_1 compared to G_2 in 34 of 54 Ss (1 tie, $p < .10$) and I_2 compared to G_1 in 26 out of 30 Ss ($p < .01$).

Ss relative to one another were not consistent in variability of initiations for either order. Rhos obtained were -.05 for I_1-G_2 and -.10 for G_1-I_2, neither significant. Unlike the results obtained for $\bar{X}$ Init., consistency of response variability is not affected by temporal order of the group or individual experience.

Galvanic Skin Potential (GSP)

Mean GSP ($\bar{X}$ GSP). The data on $\bar{X}$ GSP are shown in Figure 3. Basal levels of GSP tended to be lower during both rest periods as compared with the game period. During the game, GSP levels did not vary significantly. Moreover, differences in $\bar{X}$ GSP as a function of task reinforcement ratio were not as great as differences as a function of social condition or order.

N	SYMBOL	ORDER	CONDITION
54	△---△	1	INDIVIDUAL
	○——○	2	GROUP
30	▲——▲	1	GROUP
	●---●	2	INDIVIDUAL

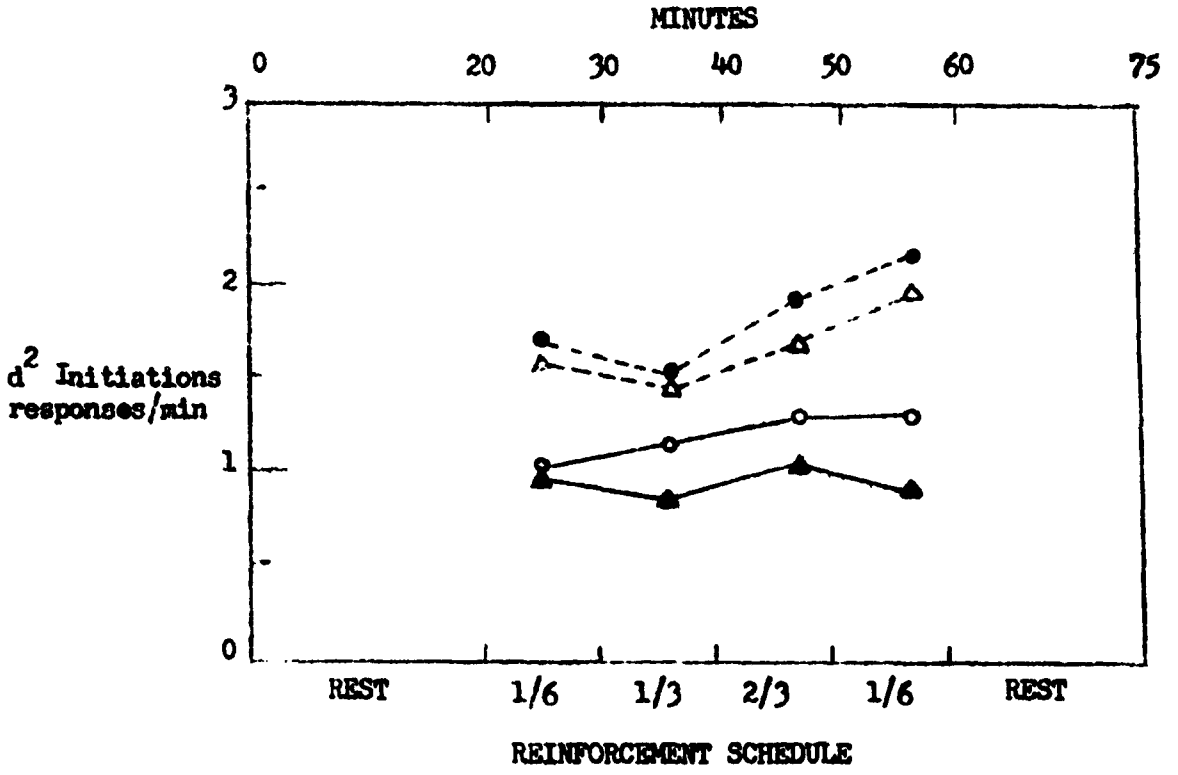

Fig. 2. Means of d^2 initiations.

N	SYMBOL	ORDER	CONDITION
54	△---△ ○——○	1 2	INDIVIDUAL GROUP
30	▲——▲ ●---●	1 2	GROUP INDIVIDUAL

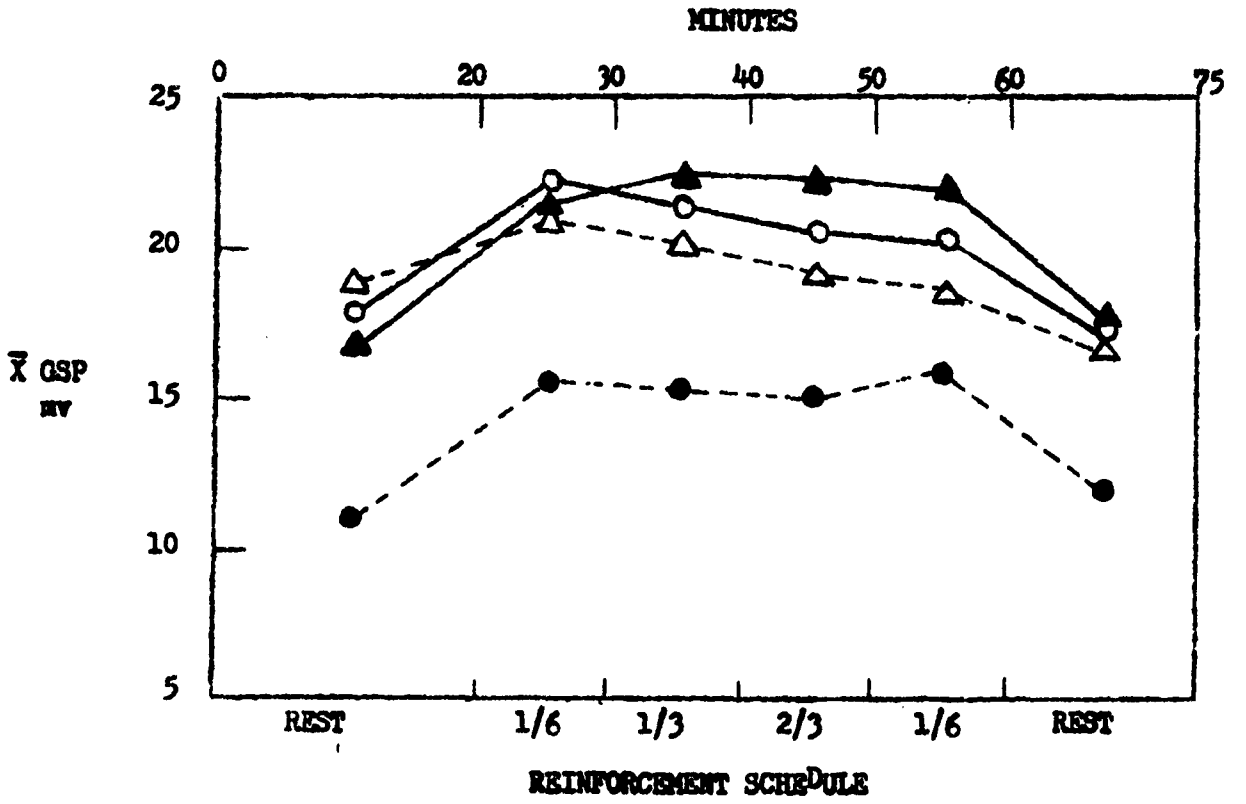

Fig. 3. Means of $\bar{X}$ galvanic skin potential (GSP).

Analysis of variance of $\bar{X}$ GSP based on the entire 40-minute game indicated $\bar{X}$ GSP was significantly higher in G as compared to I (condition effect).[4] The analysis also showed interaction of condition and order to be significant resulting from higher levels of response to a first experience as well as to the presence of others.

As to the consistency of Ss across conditions, the results approximated those found for initiations. The correlation between I_1 and G_2 was .24 ($p < .10$) and .50 ($p < .01$) between G_1 and I_2. Ss were relatively consistent in $\bar{X}$ GSP when the group situation occurred first but not when it occurred second. This finding cannot be accounted for by the correlations between number of initiations and $\bar{X}$ GSP which were all approximately zero.

Mean Square Successive Difference GSP (d^2 GSP). Figure 4 shows that d^2 GSP was higher in G as compared to I during the initial rest period and also during the final rest period. During the game differences did not follow a clear pattern.

As to the consistency of Ss relative to one another across conditions, the rank-order correlations were .65 ($p < .01$) for I_1-G_2 and .54 ($p < .01$) for G_1-I_2 indicating relatively high consistency for GSP variability in Ss regardless of experimental order.

Heart Rate (HR)

Mean HR ($\bar{X}$ HR). Figure 5 shows the mean values of $\bar{X}$ HR. The four curves are parallel for the most part and tend to fall off and converge during the game. Values for I_1 were consistently higher than those for G_2 and values for G_1 were consistently higher than I_2 indicating that HR tends to decrease over time, both within each session and from session to session.

N	SYMBOL	ORDER	CONDITION
54	△- - -△	1	INDIVIDUAL
	○———○	2	GROUP
30	▲———▲	1	GROUP
	●- - -●	2	INDIVIDUAL

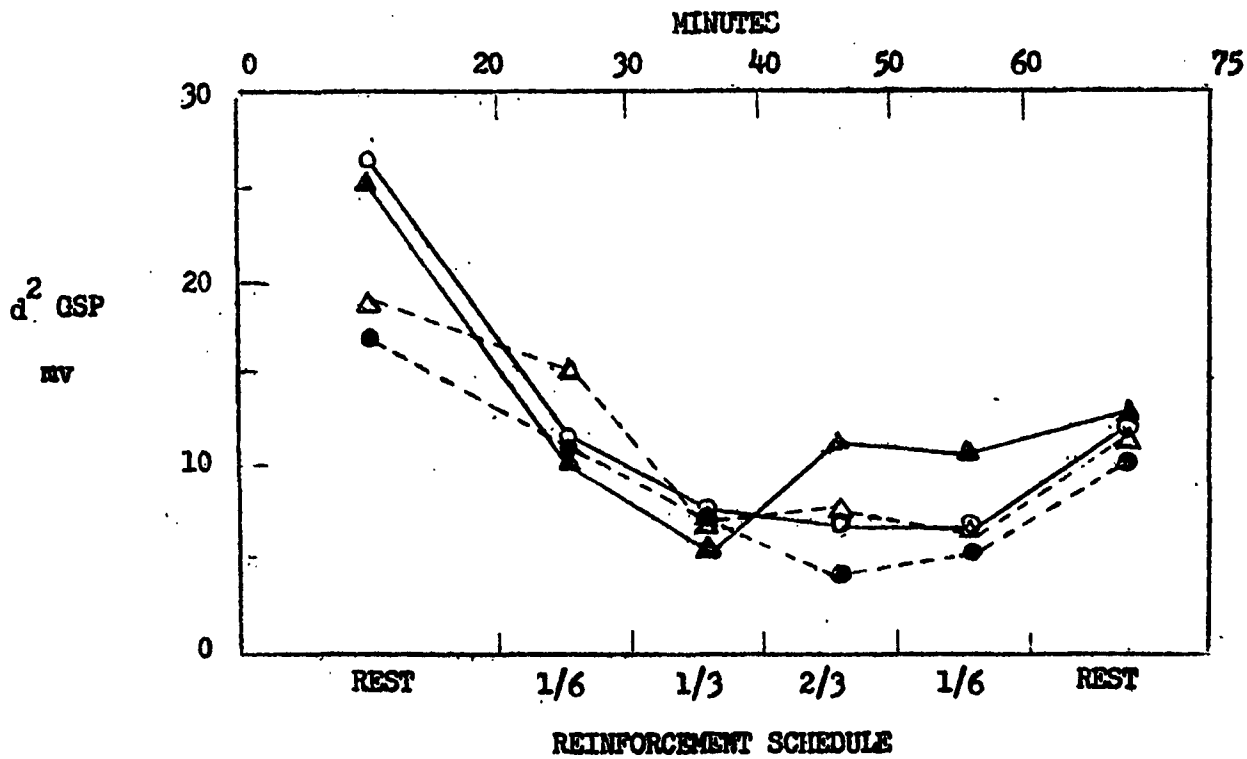

Fig. 4. Means of d^2 galvanic skin potential (GSP).

N	SYMBOL	ORDER	CONDITION
54	△---△ ○——○	1 2	INDIVIDUAL GROUP
30	▲——▲ ●---●	1 2	GROUP INDIVIDUAL

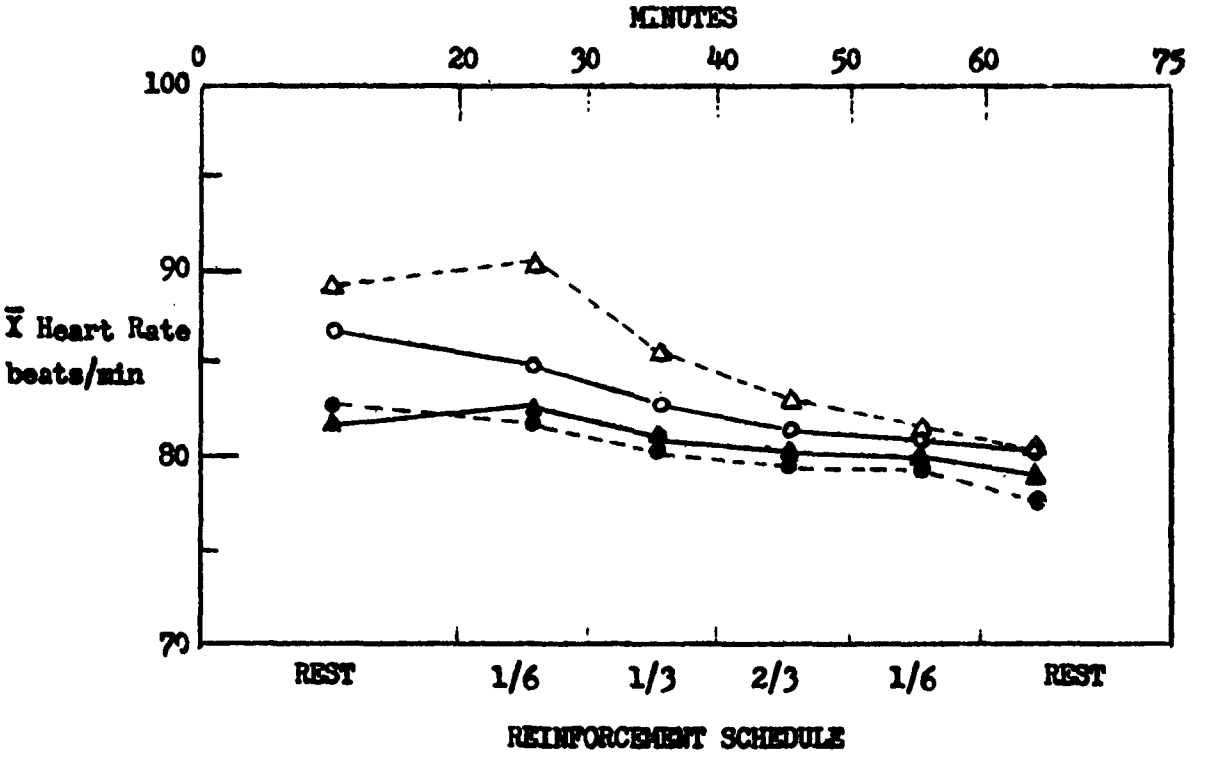

Fig. 5. Means of $\bar{X}$ heart rate.

Analysis of variance of $\bar{X}$ HR data based on the entire game period did not yield a significant overall effect due to social condition. Trends in the data are best demonstrated by comparing the mean of 85.7 beats per minute for individuals alone in I_1 with the mean of 80.5 beats per minute for individuals in groups in G_1. The mean heart rate (83.8) for I_1 and I_2 combined was in fact only slightly higher than the mean (82.2) for G_1 and G_2 combined. However, the interaction between condition and order was significant.

As to consistency, heart rate level was highly correlated across condition (rho = .69, $p < .01$, in G_2-I_1; rho = .57, $p < .01$, in I_1-G_2).

Mean Square Successive Difference HR (d^2HR). In Figure 6 d^2HR mean values vary irregularly for the most part. Under 1/3 and 2/3 reinforcement, d^2HR tended to be higher for individuals in groups as compared with individuals in isolation. As to the effects of task reinforcement, heart rate variability tended to decrease in the 2/3 period and then increase in the subsequent low reinforcement period (1/6), but the trends are not significant. However, the overall comparison of I and G for the game period did not show significant differences.

As to individual consistency, the rank-order correlation between I_1 and G_2 was .22, and .28 between G_1 and I_2, neither significant. Heart rate variability as here measured for a 40-minute time period does not have the same consistent characterization found for GSP variability (d^2GSP) as reported above.

Discussion

It was our purpose in this study to determine the effects of restricted social conditions on an individual's performance and selected physiological responses. This work stemmed in part from earlier studies in sensory

N	SYMBOL	ORDER	CONDITION
54	△---△ ○—○	1 2	INDIVIDUAL GROUP
30	▲—▲ ●---●	1 2	GROUP INDIVIDUAL

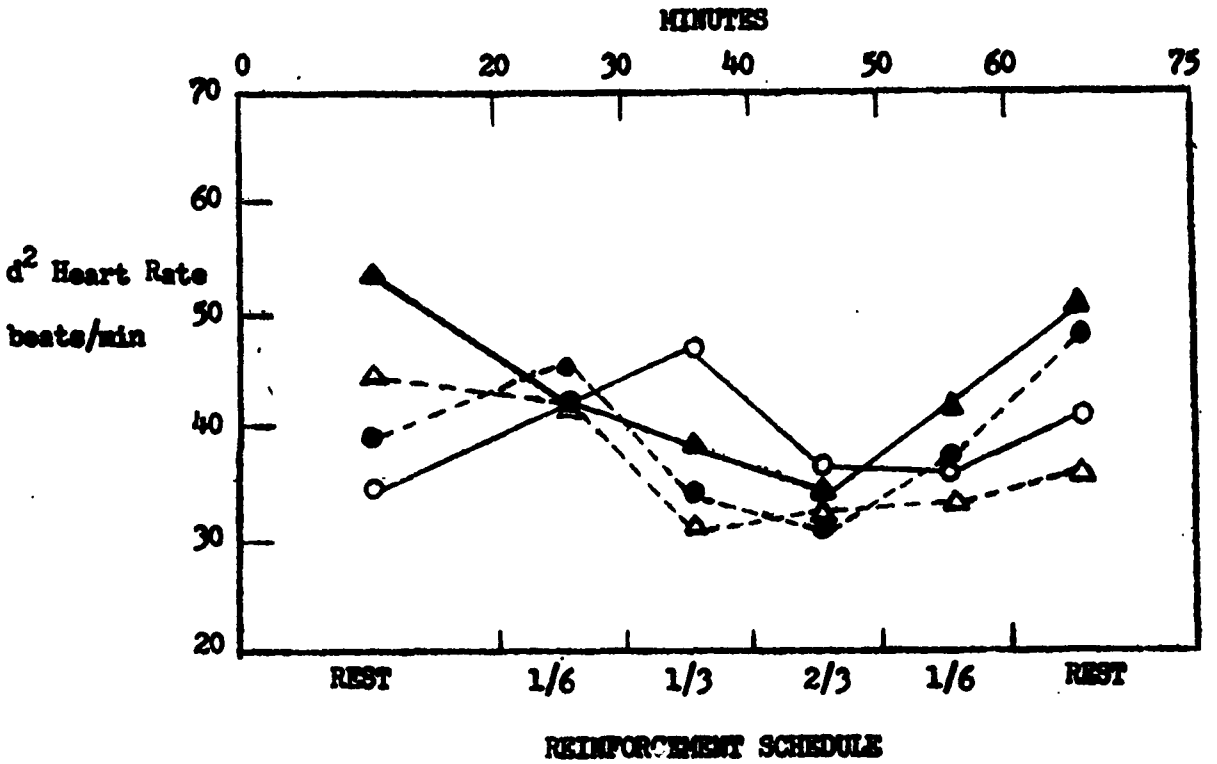

Fig. 6. Means of d^2 heart rate.

deprivation and isolation where modification in performance and psychological function were usually attributed to the restriction of physical stimuli. In order to assess some effects of social stimuli on the individual, our strategy was to employ an experimental situation in which the physical and social stimuli would be relatively standardized, and yet varying sufficiently to prevent monotony and boredom. The contrived "guessing game" was eminently suited for this purpose and easily adaptable for a single individual or a multi-person interaction. Although the particular behavioral and physiological measures employed herein were not directly related to the variables reported in the earlier isolation studies, it was felt that the establishment by objective measures of the effects of the social conditions on individual performance might help bring into perspective the relationship between physical and social stimulus conditions.

The major findings indicate that social conditions affect the mean basal galvanic skin potential and the number and the variability of behavioral acts made by an individual. For the individual, mean GSP is higher and behavioral rate and variability are lower under conditions of interaction as compared with isolation.

While the number of responses made by individuals alone was higher than the total of the three individuals in the group, the difference may be accounted for by the complexity of decision making in an interaction situation. Other studies which have dealt with similar aspects of performance alone or in groups have come up with equivocal results (Kelley and Thibaut, 1954). Undoubtedly the comparability between these studies should be examined further.

The interpretation of the physiological findings is not altogether simple. The galvanic skin measure has been conceived as an index of the level of activation following the evidence of Duffy (1957), Schlosberg (1954), and Malmo (1959).[5] This conception differs from some earlier notions of the skin measure as an index of emotion or anxiety. To what extent the change in level of activation depends simply on the greater complexity of the physical environment in a group and not on the fact that the stimuli are also social remains to be studied. Amount of speech may possibly be related to GSP level though control studies in which subjects recited numbers do not indicate that speaking leads to differences in GSP basal level. Furthermore, data based on the rest periods in which subjects were silent suggest that the presence of two other individuals may have a decided effect in itself.

Mean level of heart rate did not vary significantly in the two social conditions, but the interaction between social condition and order was statistically significant. While heart rate was higher for individuals in isolation as compared to individuals in groups, when both were first, it was also higher for the first experience, whether group or individual.

The findings of Mandler, Mandler, Kremen, and Sholiton (1961) are pertinent here. They distinguish physiological measures of activation such as galvanic skin response from measures of emotionality such as heart rate. Applying this distinction to our findings would suggest that the higher levels of heart rate obtained in the isolation situation in an initial experience may indicate a greater emotional response to being alone in a novel situation. We might hypothesize, furthermore,

that the threatening character of isolation may be especially true for women in our culture. Women are perhaps more socially oriented and therefore more comfortable in group situations as compared to men. While the group situation appears to yield somewhat lower heart rate levels than the individual situation, GSP basal level is higher in groups as compared to individuals in isolation. This finding supports the contention that the two autonomic measures (GSP and HR) are differentially responsive to social conditions.

The conclusion that social condition affects GSP and behavior is further corroborated by the higher consistency for two of the measures (GSP level and number of initiations) when the initial experience is a social one when contrasted to the lower consistency when the initial experience is one of isolation. Although the two measures yield comparable trends, the correlation between them for both the group and alone situation is low[6] suggesting that both measures may be related to some third order process, such as expectancy or set.

Mean Heart rate was highly consistent for subjects under the different conditions, regardless of order. This observation, also true for GSP variability, implies that these measures reflect some relatively stable characteristics of the individual, not as readily modifiable by social influences as mean GSP and initiations. These two physiological measures provide the opportunity to differentiate subject from situational variables, and may thus establish a basis for studies on individual differences in temperament.

Related to these relatively stable physiological characteristics is the work of Silverman, Cohen, Shmavonian, and Greenberg (1961). They

reported differences in levels of arousal, as measured by the number of non-specific GSR's and basal skin resistance, between "body-oriented" and "field-oriented" subjects, under a condition of sensory deprivation suggesting that level of arousal may be characteristic of individuals. As far as level of activation in our study is concerned, when measured by basal level GSP, the data indicate that these levels shift when the social conditions shift. While our work certainly does not minimize individual differences in level of activation, the finding of consistency when the group situation is first, and not when the individual situation is first, demonstrates that individual differences may depend on the social conditions. Whether this consistency would hold up under other more severe stimulus conditions or under different social conditions must await further work.

As to heart rate and behavioral variability, neither showed any consistency for subjects between social conditions. Both heart rate and behavioral responses are discrete measures which were analyzed by counting or estimating responses per minute for each minute interval. Variability was studied by using the mean square successive difference for the one-minute rates. This procedure did not yield clear-cut results and perhaps implies that different sampling rates or other techniques of handling such continuously-changing discrete data may be required.

The variability statistics were used in this study with the expectation that they would provide another behavioral and physiological dimension by which individual performance could be assessed. They proved useful to the extent that they provided a measure different from the basal level measures as has been found by others (Lacey and Lacey, 1958;

Speisman, Osborn, and Lazarus, 1961). The interpretation of variability measures is difficult and for the moment we believe that the findings in this study warrant their further study.

As we have shown, the order of the experience, individual and group, has different implications for the relationships observed. With respect to overt behavior, an initial group experience appears to set the individual's behavior when he is alone; while an initial experience in isolation, doing the same task, does not determine or predict how an individual will behave in a subsequent group situation. This suggests that an initial group experience provides a workable frame of reference for the individual, not only for his perceptions or judgments as Sherif (1936) has shown, but also for his level of activity in a simple task.

Similarly, we have shown that an individual's physiological response to a defined task may be more consistent and more stable while working closely with others. The group situation appears to yield higher levels of physiological activation or arousal, as we may think of basal galvanic skin potential, than the individual situation. This level of activation becomes characteristic for an individual compared to others in the same setting only if he has had the initial experience of working with two others before working in isolation, and not vice versa. Thus, it may be concluded that physiological response measures have an important place in social psychological research where an independent non-behavioral appraisal of the social conditions might be required. The results suggest that these measures are of value in separating out the differing responses of individuals to changing social as well as physical conditions.

Summary

Eighty-four women performed a simple task under conditions of social isolation and social interaction in a 3-person group. Success and failure in the task were made equivalent in both conditions, and the order of the experience was balanced. Mean level and variability of behavioral initiation, galvanic skin potential, and heart rate were compared. The results are:

1. Both level and variability of initiation were greater for individuals working alone than in groups.

2. Basal level of galvanic skin potential was higher and heart rate tended to be lower under conditions of group interaction. The variability of these measures, as measured by the mean square successive difference, did not differ between the conditions.

3. Levels of initiation and galvanic skin potential were consistent for individuals relative to one another when the group situation preceded the alone situation.

4. Individual differences in heart rate level and galvanic skin potential variability were consistent regardless of temporal order of the isolation and interaction experience.

We have experimentally demonstrated that the social setting can modify physiological response and performance of individuals. Some measures are sensitive to the social conditions and the order in which they occur, while others appear to reflect relatively stable characteristics of the individual. The findings in this study have implications for future research on the socialization of behavioral and physiological processes.

References

Duffy, Elizabeth. The psychological significance of the concept of "arousal" or "activation." Psychol. Rev., 1957, 64, 265-275.

Edwards, A. I. Experimental design in psychological research. New York: Holt, Rinehart and Winston, 1950. P. 233.

Kelley, H. H., and Thibaut, J. W. Experimental studies of group problem solving and process. In G. Lindsey (Ed.), Handbook of social psychology. Vol. II. Cambridge, Mass.: Addison-Wesley, 1954. Pp. 735-785.

Lacey, J. I., and Lacey, Beatrice C. Verification and extension of the principles of autonomic response stereotypy. Amer. J. Psychol., 1958, 71, 50-73.

Leiderman, P. H., and Shapiro, D. Application of a time series statistic to physiology and psychology. Science, 1962, 138, 141-142.

Leiderman, P. H., and Shapiro, D. A physiological and behavioral approach to the study of group interaction. Psychosom. Med., in press.

Leiderman, P. H., Sherwood, M. R., and Kaufmann, Marion R. A study of the galvanic skin potential basal level and specific response measures. In preparation.

Levin, G., and Shapiro, D. The operant conditioning of conversation. J. exp. anal. Behav., 1962, 5, 309-316.

Malmo, R. B. Activation: A neuropsychological dimension. Psychol. Rev., 1959, 66, 367-386.

Mandler, G., Mandler, Jean M., Kremen, I., and Sholiton, R. D. The response to threat: Relations among verbal and physiological indices. Psychol. Monogr., 1961, 75, 1-22.

Petrullo, L. Small group research. In A. J. Bachrach (Ed.), Experimental foundations of clinical psychology. New York: Basic Books, 1962.

Schlosberg, H. Three dimensions of emotion. Psychol. Rev., 1954, 61, 81-88.

Sherif, M. The psychology of social norms. New York: Harper, 1936.

Silverman, A. J., Cohen, S. I., Shmavonian, B. M., and Greenberg, G. Psychophysiological investigations in sensory deprivation. Psychosom. Med., 1961, 23, 48-62.

Solomon, P., Kubzansky, P. E., Leiderman, P. H., Mendelson, J. H., Trumbull, R., and Wexler, D. (Eds.) Sensory deprivation. Cambridge, Mass.: Harvard University Press, 1961.

Speisman, J. C., Osborn, J., and Lazarus, R. S. Cluster analyses of skin resistance and heart rate at rest and under stress. Psychosom. Med., 1961, 23, 323-343.

Tursky, B., Leiderman, P. H., and Shapiro, D. A system for recording and processing psychophysiological and behavioral data. Psychophysiol. Newslltr., 1962, 8, 24-30.

von Neumann, J., Kent, R. H., Bellinson, H. R., and Hart, B. I. The mean square successive difference. Ann. Math. Statist., 1941, 12, 153-162.

Footnotes

1 The research was supported by Career Investigatorship Award M-2276 and Research Grant M-4209 from the National Institute of Mental Health, United States Public Health Service; also by Office of Naval Research Contract Nonr-1866(43), Group Psychology Branch.

We wish to thank Mr. Bernard Tursky for constructing and maintaining experimental apparatus and physiological recording equipment, Mr. George Saadis for helping to conduct the experiments and analyze the results, and Mrs. Catherine Hanley for all-around secretarial help.

2 Sampling the GSP basal level once every two seconds (i.e., 15 samples per minute), and comparing to the sampling rate of once per minute, revealed an average difference in the value for each minute of < 1.0 mv. This difference is less than the error of $\pm$ 1.0 mv expected using our recording technique.

3 In comparing this sampling method with a method of counting all the beats, the average algebraic difference over the experimental period was less than .65 beats per minute, approximately 1% error.

4 This analysis, based on the model described in Edwards (1950, p. 233), was applied to $\bar{X}$ GSP and $\bar{X}$ HR only. Non-parametric techniques were used in analyzing the behavioral and the physiological variability measures because it could not be assumed that these statistics are normally distributed.

5 Conductance measures have been generally employed in these studies. Unpublished data from our laboratory indicate that the potential method of measuring skin response is comparable to the resistance method.

6 These interrelationships will be discussed in greater detail in a forthcoming paper.